POTENTIAL CROPS IN BALIDONG RESEARCH AND DEVELOPMENT, EXTENSION (R & D/E) LABORATORY[1]

by

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KEY WORDS: soil properties, soil fertility, rock outcrops, soil pH, soil texture, vegetable crops, fruit crops, ornamental crops, plantation crops

ABSTRACT

The study was conducted to determine some potential crops in Balidong research and development and extension (R & D/E) laboratory of Mountain Province State Polytechnic College (MPSPC) at Tadian, Mountain Province for extensive crop production on the bases of soil properties (fertility, pH, texture, depth and outcrops) and climate (relative humidity, temperature, and rainfall). Results indicated that most crops have potential for extensive production in Balidong R & D/E laboratory despite the low fertility status of the soil in terms of the major elements (N, P, K) required by crops and the presence of rock outcrops or gravels in some portions of the area. Soil nitrate nitrogen ranges 10-15 lb/acre (trace), available soil phosphorus is from <10-75 lb/acre (trace to medium), and available soil potassium is <100 lb/acre (medium). The soil pH or acidity range from 5.5-6.0 indicating the soil is slightly to moderately acidic. Most of the soil samples analyzed are coarse textured (loamy sand and sandy loam). Only few are fine textured (loam). Generally, soil depth exceeds 50 cm (higher areas of the R & D/E lab) although some portions only have 4-5 cm (lower areas of the R & D/E lab) due to the presence of rock outcrops. Climatic data was also promising for extensive crop production with mean annual minimum and maximum temperatures of 14.19 ºC and 23.93 ºC, respectively; mean average annual rainfall amount (total rainfall) of 111.81 mm and average total rainfall of 1988.35 mm, and mean annual relative humidity of 84.36 %.

INTRODUCTION

Land may be classified into different suitability classes depending on slope, soil properties and characteristics, and water supply. With respect to lands suitable for agriculture and forestry where production and nature conservation are the primary goals, soil properties and characteristics must be considered.

If almost all types of soil can mechanically support plant life with equal ease, why are some lawns greener than others, why do some gardens produce larger flowers or

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vegetables than others and why do certain farms produce higher yields than others? It is the presence of available plant nutrients that may determine if the plants will grow to a lush, full maturity or whether the plant will develop as a stunted, off-color miniature of what it should be. A fertile soil is one that is able to supply the complete dietary needs of the growing plant (Foth, 1970).

Soils vary in fertility and productivity. However, fertile soils are not always productive and infertile soils are not always productive. This means that soil fertility can be managed to make the soil productive. Like soil fertility, soil pH can be managed to suit the pH requirement or preferences of crops intended for cultivation. Soil texture though is a soil property that cannot be altered to suit textural preferences of crops. It may therefore be used as an initial reference for crop suitability of soils. In addition to this is soil depth and absence of any obstruction like rock outcrops along the soil profile that may limit or hinder root development especially for deep-rooted crops.

Climate, on the other hand, as another factor of plant growth is a variable that can be used to determine what crops are suitable in an area given the fact that it is difficult to manage or control. The absence of river systems or tributaries like headwaters within reach and of easy access to the area of concern will mean that the area under consideration shall be dependent on rainfall as primary source of water supply for irrigation purposes especially for extensive crop production. Irrigation systems, of course, may be constructed from river bodies as water source purposely for intensive crop production but would entail a lot of expense on the part of the farmer, worse if the water sources were remote.

This is not also to set aside the influence of temperature and relative humidity on plant growth and development, because both do not only directly influence crop growth but also the occurrence and or incidence of crop pests like insects and fungi.

Matching then the existing environmental conditions of a place with the preferences of crops as to soil properties and climate gives one a useful tool for determining the suitability of an area to crop production or whether a crop can be grown productively in an area.

Thus, it was the aim of the study to determine (1) the existing environmental condition in Balidong R & D/E laboratory on the bases of rainfall distribution type to which the area under consideration belongs, mean annual minimum and maximum (air) temperatures (ºC), mean total annual rainfall (mm & tenths), mean annual relative humidity (%), soil depth, soil pH, soil texture, soil fertility (N, P, K only), and the presence or absence of rock outcrops on the soil surface and along the soil profile, and (2) what crops may be suitable or have potential for extensive production in Balidong R & D/E laboratory.

The Balidong R & D/E laboratory is located in Tadian, Mountain Province along the tri-boundary of barangays Kayan, Bunga, and Lubon having an elevation of 1,030 m above sea level (ASL). It is approximately 2 km away by foot WSW from the Mountain

Province State Polytechnic College, College of Engineering and Technology by way of the pine forest below or South of the arena field. The field laboratory has geographical coordinates of 17 º 00' N Lat. and 120 º 48' E Long.

Horticultural classification of crops as used in this study were defined (Bautista, 1994) as follows: vegetable crops—a succulent plant or plant part usually eaten as a supplementary food in cooked or raw form, and is neither a sweet fruit nor a mature grain; fruit crops—(crops bearing) fruit (that) is . . . edible, more or less fleshy botanical fruit of a perennial plant usually used in fresh form; ornamental crops—plants used for their aesthetic or decorative value; plantation crops— . . . crops usually perennial in growth and that require minor changes in the structure of the product through primary processing before utilization.

METHODOLOGY

Problems. The following were the problems this research aimed to answer; (1) What is the existing soil conditions in Balidong R & D/E field laboratory?, (2) What is the prevailing climatic condition in Balidong R & D/E field laboratory?, and (3) What crops are potentially suitable for extensive production in Balidong R & D/E field laboratory?

Methods. Soil samples at plow depth (30 cm) were taken from the Balidong R & D/E laboratory following the standard procedure on soil sampling. A one-foot length La Motte soil sampling tube (saw-toothed) was used. The area was subdivided into four sampling sites and a composite sample of ten samples for each site was obtained.

The samples were air-dried at room temperature following the standard procedure on soil preparation. After one week of air-drying, the samples were analyzed of nitrate nitrogen, available phosphorus, available potassium and soil texture following the colorimetric method with the use of the LaMotte Soil Analysis Outfit and LaMotte Soil Test Kit. Soil texture determination was also carried out following another procedure called the "roll and feel" method or field method for comparison with the LaMotte methodology and to serve as complementary analysis.

Existing land uses in each site (vegetation) was also noted for reference. In like manner, soil depth was observed in areas within each site like gullies and slope cuts from slides in correlation to observed tree growth and dominant vegetation type.

Climatic data were obtained from the Benguet State University—Philippine Atmospheric, Geophysical and Astronomical Services Administration (BSU—PAGASA), which is the nearest weather station to Balidong R & D/E laboratory (approximately 124 km away). BSU—PAGASA is located at km. 5, La Trinidad Benguet with an elevation of 1,317.4 m ASL and a geographical coordinates of 16 º 21' N Lat. and 120 º 35' E Long.

The data obtained were minimum and maximum air temperatures (ºC), relative humidity (%), and rainfall amount (mm & tenths). All data received were on daily basis; hence the average annual values were computed from computed mean monthly values in a year. On the other hand, mean annual values, which are the mean of computed average annual values from six years and six months duration, were calculated. Necessary informations were also obtained about the rainfall distribution type in the Philippines with its corresponding map called the "Climate Map of the Philippines Based on Modified Coronas Classification".

Determining the rainfall distribution type to which Balidong R & D/E laboratory belongs was made by rough plotting the coordinates of the field laboratory against the climate map of the Philippines and the geographic map of Mountain Province and the Philippines.

Potential crops in Balidong were also identified by matching the existing environmental conditions in the field laboratory with that of the environmental requirements of the crops. The crops considered in this study include vegetable, fruit, ornamental, and plantation crops. However, not all crops under the just mentioned classifications were included due to insufficient references (available to the researcher) on their environmental requirements.

RESULTS AND DISCUSSION

Soil Condition. The soils at the Balidong R & D/E laboratory is generally low fertile with reference to the major plant-available nutrient elements; nitrate nitrogen, available phosphorus, and available potassium (Table 1).

Table 1. Soil conditions in Balidong R & D/E laboratory

Soil Properties	Existing Conditions
pH	5.5 to 6.0
texture	
"Roll & Feel" or Field procedure	sandy clay loam to clay loam
depth	<2.5 cm to 50 cm or more
fertility	
nitrogen (lb/acre)	10 to 15
phosphorus (lb/acre)	<10-10
potassium (lb/acre)	<100 or medium to very high

Most mineral soils are actually deficient of nitrogen though it composes 80% of the earth's atmosphere, because most of which reap no benefit to plants unless converted to plant-available form. Thus the most common sources of nitrogen for plant growth and development is through the decomposition of organic matter and application of nitrogen-containing fertilizers.

Acid soils are generally low in phosphorus especially if the soil is high in clay content due to chemical and mechanical fixation, respectively, rendering the plant-available phosphorus into unavailable form.

However, low phosphorus in Balidong soils seems not to be wholly due to acidity because the soil is only moderately to slightly acid (Table 1). Although there was a disagreement between results of two textural determination procedures (data not shown), visual observations on gullies and rills indicated that those obtained through field method (Table 1) is more reflective of the condition in the area. Hence, low phosphorus in Balidong could partly be due to clayey soil texture.

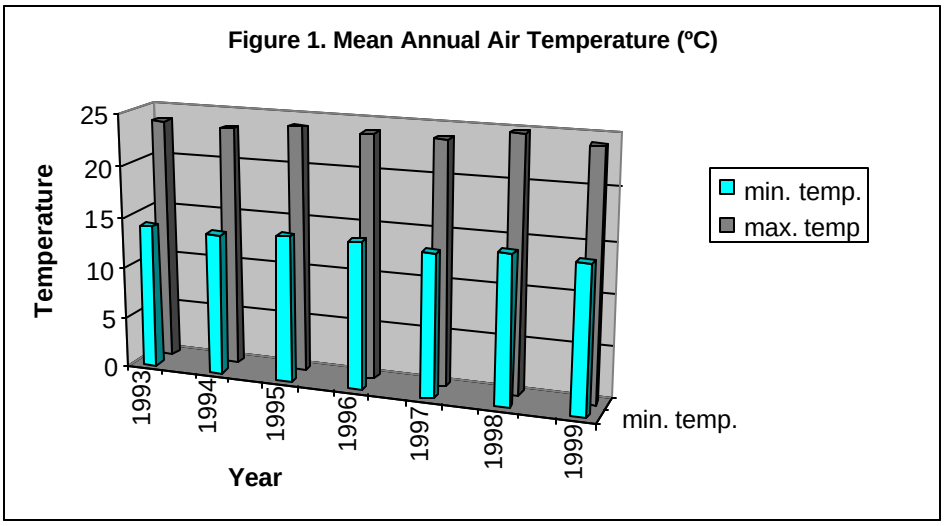
Potassium, on the contrary, was not that low in amount; yet fertilization might still be necessary for crops requiring high amounts or supply of potassium. Soils high in clay content usually have relatively high potassium content.

Field observations during soil sampling revealed that rock outcrops or the presence of gravelly soils in lower portions of Balidong limits the suitability of the area for deep-rooted crops. Worse, clay pans seem to form in higher portions of Balidong, which might also hinder good root development for deep-rooted plants.

Those areas samples with rock outcrops are also those having shallow depth of <2.5 cm to 5.0 cm for the average while the rest of the area have a depth of at least 50 cm or more (Table 1).

Climate. Climatic data revealed that Balidong R & D/E laboratory and extreme western Mountain Province belong to the type 1 climate of the Philippines based on the modified coronas classification (data not shown).

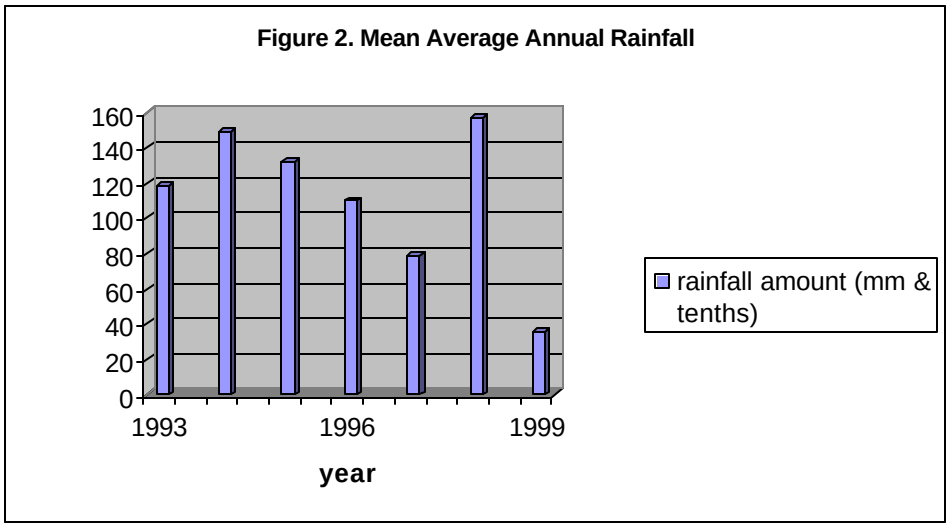
Extremes of mean monthly temperature were recorded in the months of June and December with 25 ºC and 10.83 ºC, respectively (data not shown). Mean annual temperature, on the other hand, ranges from 13.77 ºC to 24.8 ºC (Figure 1) with an average annual temperature of 19.28 ºC.



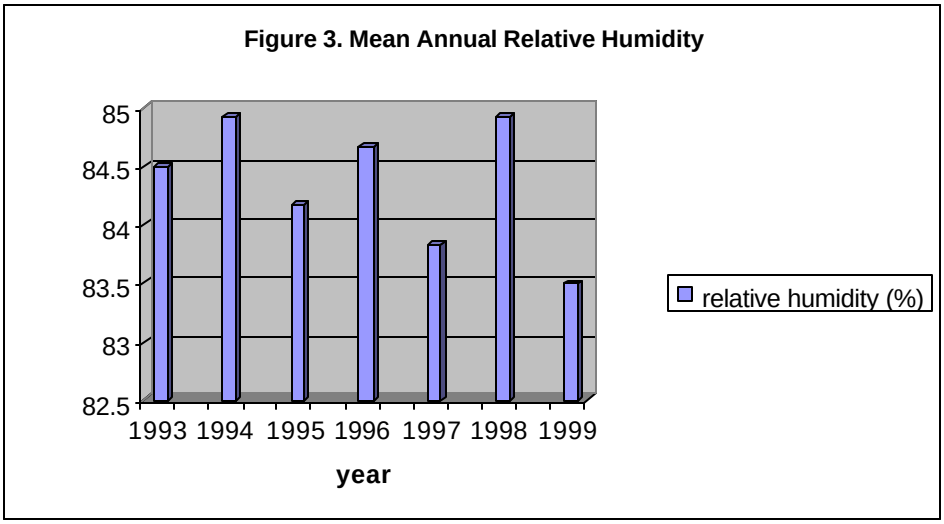
The computed mean average annual rainfall (total rainfall) from raw data obtained is equal to 111.81 mm while the computed average total rainfall is 1988.35 mm (data not shown), which is way below the average annual rainfall in Luzon that is 2,724 mm (Bautista, 1994).

Lowest recorded average annual rainfall is 78.8 mm on 1997 (Figure 2) while the highest recorded average annual rainfall is 157.45 mm the following year based on data recorded from 1993 to 1999. Moreover, the highest average monthly rainfall was recorded during the months of October (162.7 mm), August (119.6 mm), and July (117.8 mm); while the least average monthly rainfall was recorded during the months of January (2.42 mm), February (2.66 mm), and December (5.4 mm) (data not shown).

The low rainfall amount recorded for the year 1999 was primarily due to incomplete data received—that is, it reflects only those data recorded from January to June.



On the other hand, it was observed that mean annual relative humidity (%) generally decreases and increases with respect to average annual rainfall (mm & tents) (Figure 3). The highest mean annual relative humidity is recorded both on 1993 and 1998 (84.92 %) while the lowest is on 1999 (83.5 %) and 1997 (83.83 %) (Figure 3). Low relative humidity for the year 1999 was due to data obtained only from January to June.



Mean monthly relative humidity also decreases from October to December and increases again from January to September but does not fall below 80% and does not go beyond 90% (data not shown). Mean monthly relative humidity is generally higher than mean annual relative humidity with the lowest and highest mean monthly relative humidity of 80.57 % (February) and 88.33 % (August), respectively (data not shown).

However, the mean annual relative humidity is still slightly higher than the average relative humidity in the Philippines that is 82.0 % (Bautista, 1994).

Potential Crops. The following are some potentially suitable crops in Balidong R & D/E laboratory for extensive production based on existing soil conditions and climatic condition, and the crops' environmental requirements.

Table 2. Some potential crops in Balidong R & D/E laboratory for extensive crop production

Horticultural crop classification	Potentially suitable crops
vegetable crops	vegetable legumes, garlic, bittergourd, eggplant, soybean, carrots, green onion, pechay, squash, ginger, yam
fruit crops	citrus, pineapple, jack fruit, mango, banana
field crops	garlic, rice, sorghum, corn, ginger, yam, carrots, sweet potato, peanut, soybean
plantation crops	coffee, tea
timber or forest crops	pine tree, acacia, calliandra, cypress, leucaena or ipil-ipil, eucalyptus

CONCLUSION

1.) Results of soil analyses and observations showed that soil conditions in Balidong R & D/E laboratory can support crops for extensive production. The slope of the land (35% to 45%) also limits the soils capability to support other crops either for intensive or extensive crop production due to potential danger of soil erosion and soil loss. These effects, however, may be mitigated in the case of extensive production by planting the crops along the contour coupled by terracing (e.g. bench terrace).
2.) Rainfall amount, relative humidity, and minimum and maximum temperature (uncorrected) obtained from the BSU-PAGASA monthly returns showed that most crops like vegetables can be produced extensively in Balidong.
3.) Matching gathered informations on the environmental requirements of most crops with the prevailing climate and existing soil conditions in Balidong R & D/E field laboratory revealed that the most potentially suitable crops in the area are highland plantation crops, sub-tropical or semi-tropical fruit crops, semi-temperate vegetable and field crops, and sub-tropical to semi-temperate timber or forest crops.

RECOMMENDATIONS

1.) Balidong R & D/E field laboratory is best suited for extensive crop production only due to land limitations like erosion-prone soil texture and slope, and heavy rainfall that is experienced at the site. Thus, proper soil management including soil fertility management (due to poor soil fertility on the major fertilizer elements) is highly encouraged not only to conserve the soil but also to indirectly conserve soil fertility by mitigating soil loss. Organic farming is also encouraged to increase soil fertility in the long term while improving the

physical structure of the soil. Maintenance liming is also advised when cultivating crops (e.g. legumes) requiring moderate to neutral acidity.

2.) The climate data obtained and computed for the study reflect that of La Trinidad, Benguet and not Tadian, Mountain Province. Hence, proper correction should be made to determine the nearest approximation on climate condition in Balidong R & D/E field laboratory taking into consideration the elevation of both sites.

3.) Matching simply the environmental requirements of crops with prevailing climate and soil conditions in an area of land does not guarantee the success of production (profitability). These are but external or environmental factors affecting crop growth and development and do not include other factors such as biological factors (pests and diseases), genetic and or physiological factors (internal factors or varietal factors), and crop management factors. Actual suitability of crops to a certain land should be made or evaluated considering all said factors, because land suitability evaluation for crop production serves only as a guide for agricultural development of the area. Thus, the crops enumerated in Table 2 are but potentially suitable crops.

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